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CHARACTERISATION OF BACKGROUND BIOLOGICAL AEROSOL

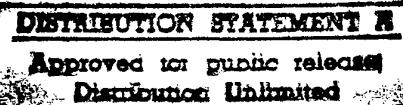
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CONTRACT NUMBER: N68171-96-C-9124

3rd Interim Report

April 1997 - June 1997



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13. ABSTRACT (Maximum 200 words) <p>Sampling of ambient air using a glass cyclone system for fluorescence background determination is described. Weekly samples over 12 hour sampling periods are taken at the University College Galway's atmospheric research field station at Mace Head, on the west coast of Ireland. The bioaerosol sampling system and procedures used have previously been discussed in the 1st Interim Report. Use is made of a fluorescence protocol developed in the ERDEC Laboratories.</p> <p>Representative fluorescence excitation/emission spectra are presented and compared for both background and polluted conditions. Intercomparison between Winter and Spring signatures is made.</p>			
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CHARACTERISATION OF BACKGROUND BIOLOGICAL AEROSOL

Abstract

Bioaerosol sampling has been carried out at Mace Head on the West coast of Ireland on a weekly basis. Sampling time has been increased from a three hour to a twelve hour period as from January 31st, 1997. Representative fluorescence excitation/emission spectra are presented for both background and polluted air conditions over the period from 11/29/96 to 05/08/97.

1. Introduction

Biological monitoring is carried out at Mace Head for three reasons, firstly to determine the influence of the Atlantic ocean on bioactivity, secondly to establish a “baseline” for future remote biological sensing systems and thirdly for the investigation of the correlation of bioaerosol data with non-viable data already available at Mace Head. The method currently in use at Mace Head for capturing airborne biological material is an impinger system and the model type is an Aerojet General glass cyclone. The impinger system relies on the fact that a known quantity of air is pulled at a high velocity through a fluid in a glass vessel. Aerosolised biological matter are retained in the washing fluid while the air passes through the fluid and out through the pump system. The high, almost sonic air speed used in impinger devices results in high shear forces which breakup bacterial/particulate aggregates so that the total count obtained closely reflects the actual number of viable organisms. This shearing action differentiates impingement from other methods, all of which measure only the number of bacteria bearing spores which give colony forming units (cfu). Sampling and fluorescence measurement protocols used have been documented in the 1st Interim report.

2. Background Aerosol Characterisation

Twelve hourly bioaerosol samples were collected at Mace Head from 01/31/97 onwards, replacing the previous 3 hour sampling period. Sampling times in Greenwich Mean Time (GMT) are given in Table 1. Representative emission spectra based on the Winter months of November, December, January and February and the Spring months of March, April and May are shown in Figure 1 through Figure 3. Data includes bioaerosol samples from

both marine (wind sector 180-300°) and continental (wind sector 45-135°) air masses, and are summarised in Table 2. In addition to the condition that the wind direction is between 180 and 300°, a further constraint was imposed to ensure marine air mass conditions. It was required that the condensation nuclei (CN) number concentration be < 700 cm⁻³.

Table 1. Bioaerosol sampling times.

Date	Sampling Times-GMT
11/29/96	11:15-14:15
12/06/96	11:15-14:15
01/09/97	11:45-14:45
01/13/97	10:30-13:30
01/31/97	01:00-13:00
02/07/97	01:00-13:00
03/13/97	04:00-16:00
03/19/97	21:00-09:00
04/03/97	04:00-16:00
04/24/97	04:00-16:00
05/02/97	05:00-17:00
05/08/97	04:00-16:00

Table 2. Bioaerosol measurement periods.

Season	Date	Wind Sector
Winter	11/29/96	Marine
	12/06/96 ^a	Modified marine
	01/09/97	Continental
	01/13/97	Marine
	01/31/97	Continental
	02/07/97 ^b	Modified marine
Spring	03/13/97	Marine
	03/19/97	Marine
	04/03/97 ^c	Modified marine
	04/24/97	Marine
	05/02/97 ^d	Modified continental
	05/08/97 ^e	Modified marine
a: Wind direction was 150° for the 3 hour period. b: Wind direction was 300-324° for 3 hours. c: Wind direction was 300-312° for 9 hours. d: Wind direction was 150° for 1 hour. e: Wind direction was 300-310° for 7 hours.		

Emission spectra have been grouped by the excitation wavelengths 282, 350 and 450 nm. Back trajectory data for all selected dates are displayed in Figure 4 (a) to Figure 4 (l), courtesy of Peter Lynch and Liam Campbell at Met Éireann. The calculations for each trajectory are based on a 4 day period up to midday of the specified dates.

Marine and modified marine fluorescence intensity values at excitation wavelength 282 nm do not show any significant increase in relation to increased sampling time over the Winter-Spring period. An exception occurs on the 05/08/97 (Figure 1 (k)) where there is a comparatively large increase in intensity during a modified marine sampling period. Hourly CN number concentration for the same period were $< 700 \text{ cm}^{-3}$ and do not show any dominant continental influences.

The highest continental signal at 282 nm occurs on the 01/09/97, (Figure 1 (d)). Continental fluorescence intensity values are relatively low on the 01/31/97 (Figure 1 (f)) and 05/02/97 (Figure 1 (l)). Intensity values on the 01/31/97 are lower than the adjacent modified marine (Figure 1 (e)) sampling period.

At 350 nm the fluorescence emission signal for the continental air masses - Figure 2 (d), Figure 2 (f) and Figure 2 (l) exceed that of the marine signal (Figure 2 (c)) and that of modified marine signals (Figure 2 (e), Figure 2 (k)) in comparing measurements taken at fairly close periods to one another. The greatest fluorescence occurs on 01/09/97 for a continental air mass, similar to that for excitation at 282 nm.

Fluorescence intensity values at 450 nm are extremely low with the strongest signal occurring on the 01/09/97 (Figure 3 (d)).

Figure 1 (a) 11/29/96 Marine

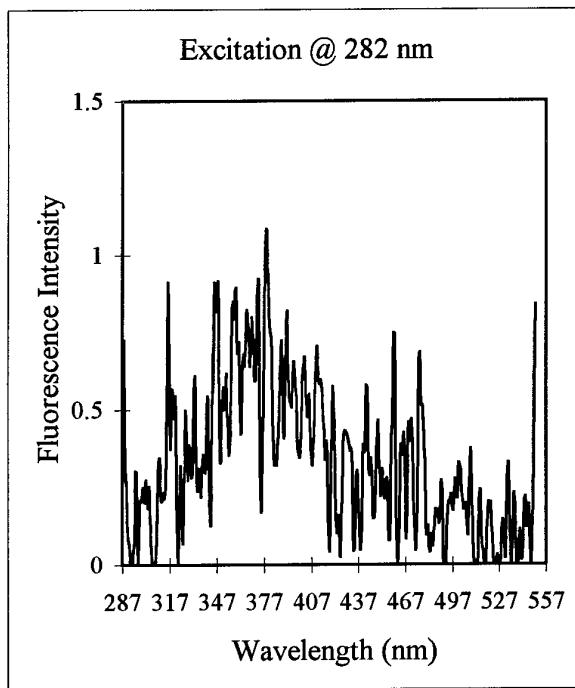


Figure 1 (b) 12/06/96 Modified marine

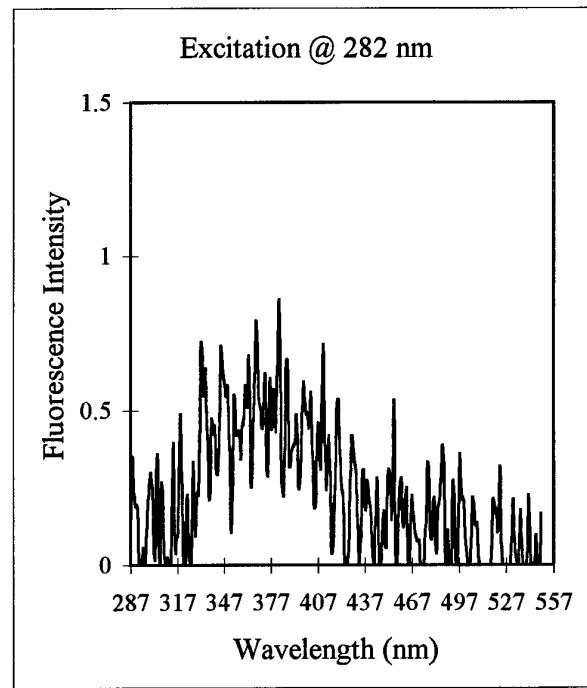


Figure 1 (c) 01/13/97 Marine

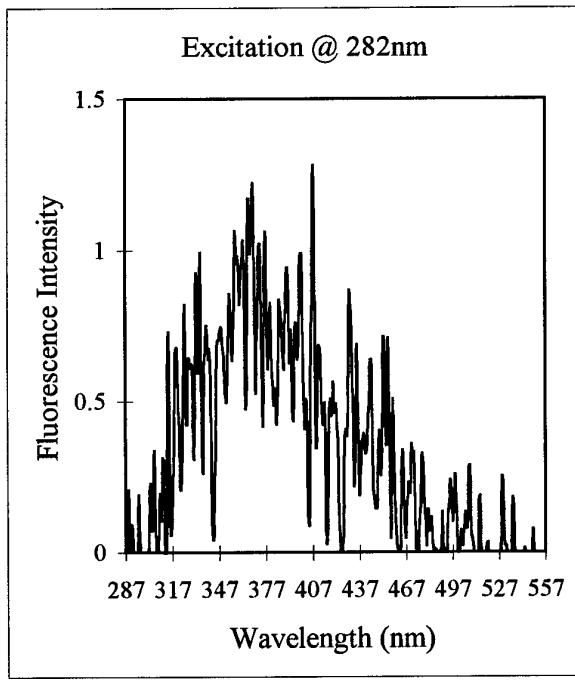


Figure 1 (d) 01/09/97 Continental

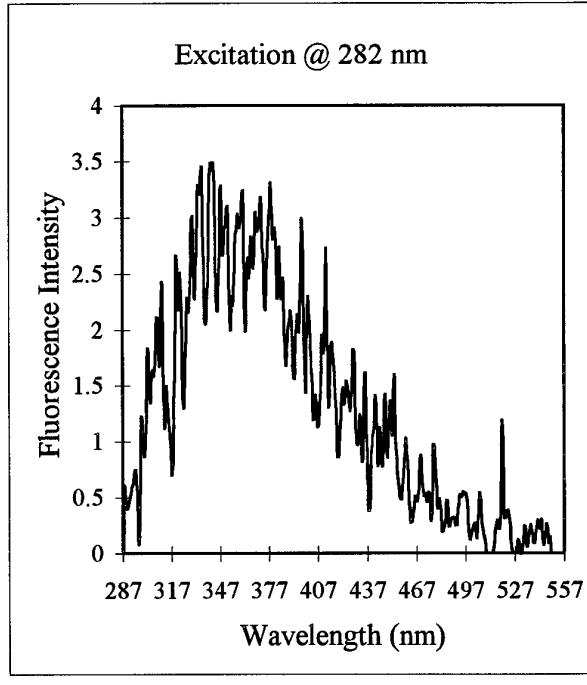


Figure 1 (e) 02/07/97 Modified marine

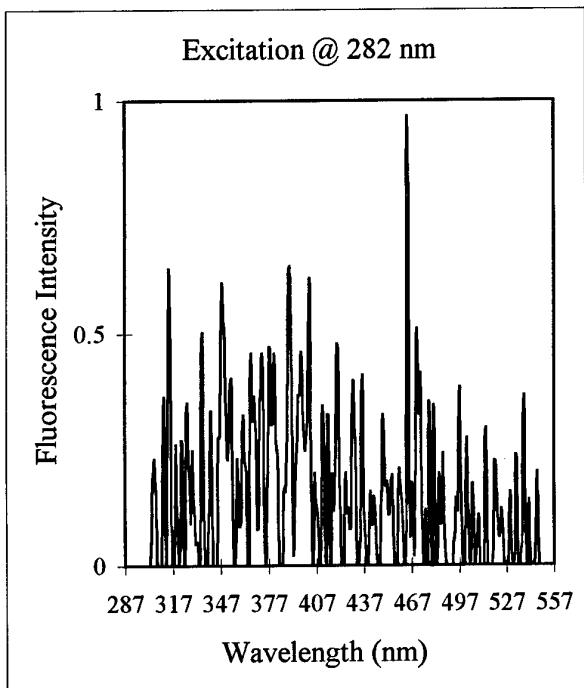


Figure 1 (f) 01/31/97 Continental

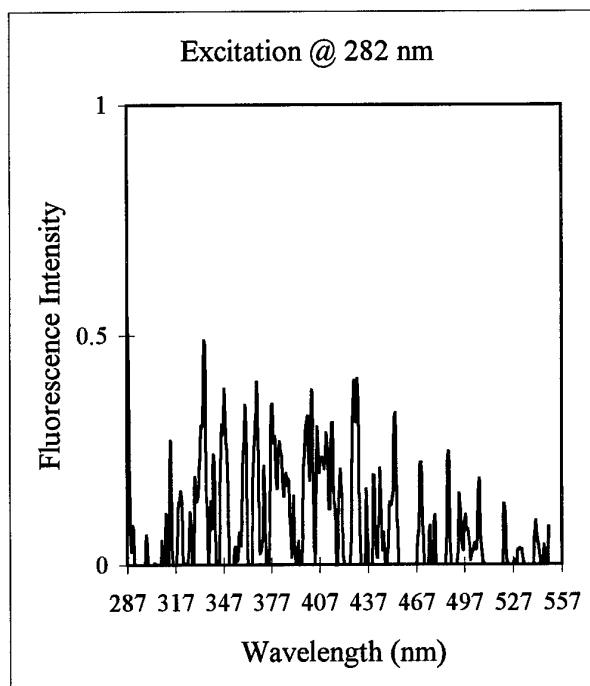


Figure 1 (g) 03/13/97 Marine

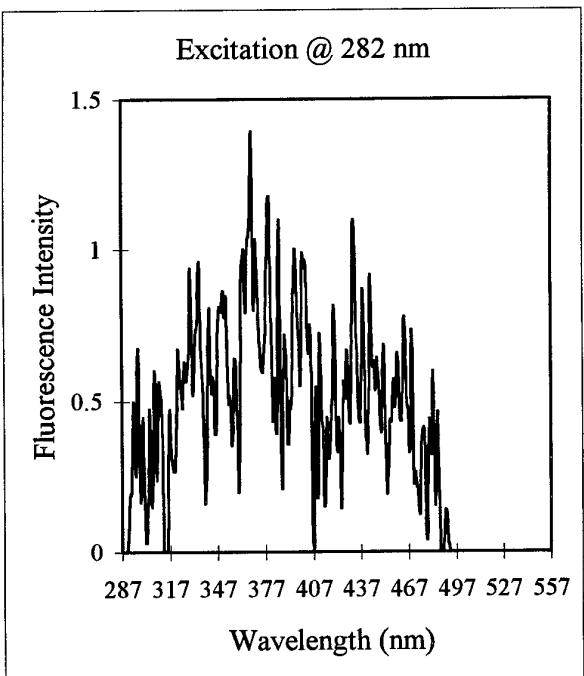


Figure 1 (h) 03/19/97 Marine

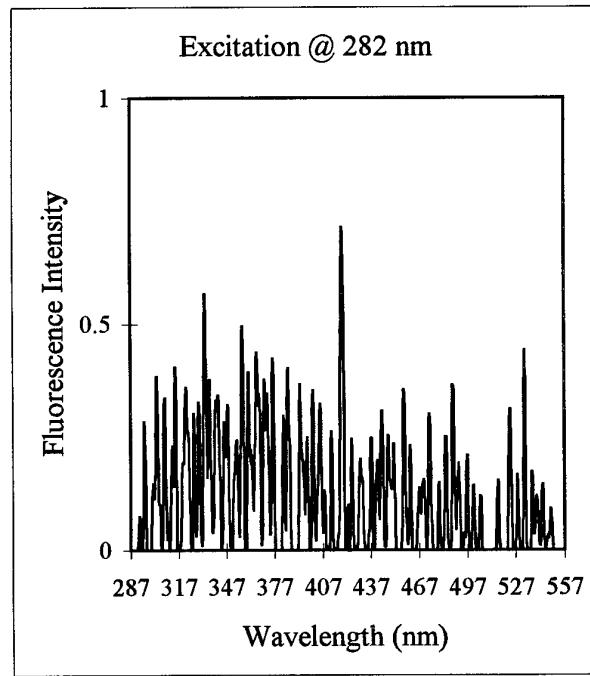


Figure 1 (i) 04/03/97 Modified marine

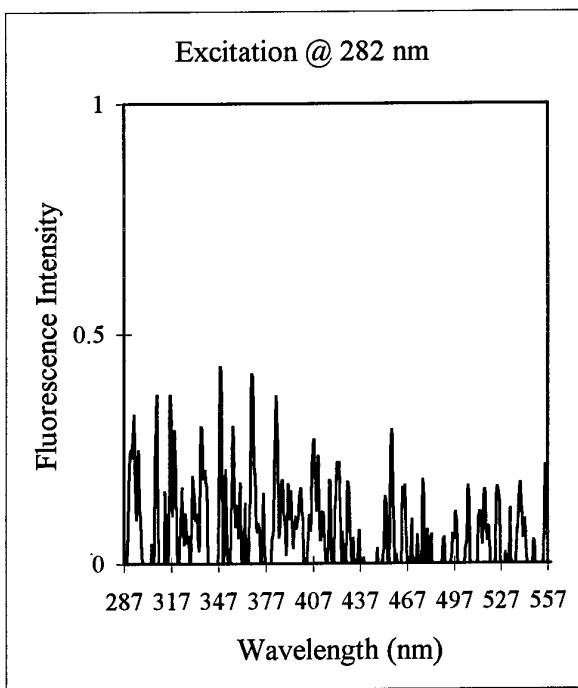


Figure 1 (j) 04/24/97 Marine

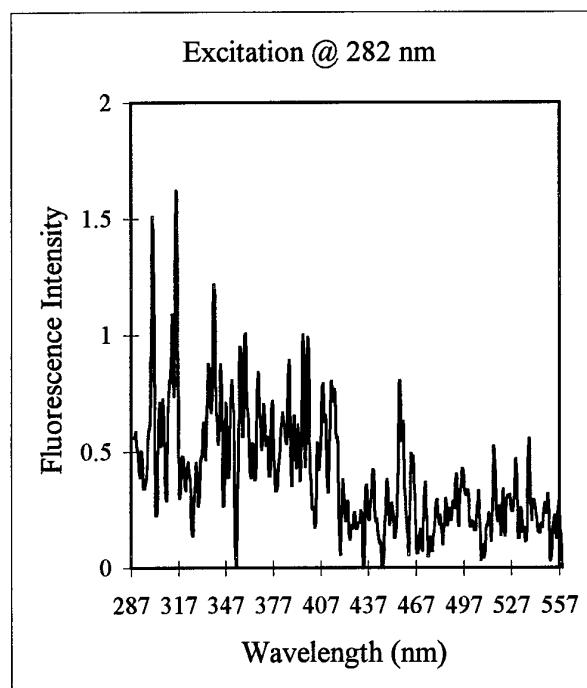


Figure 1 (k) 05/08/97 Modified marine

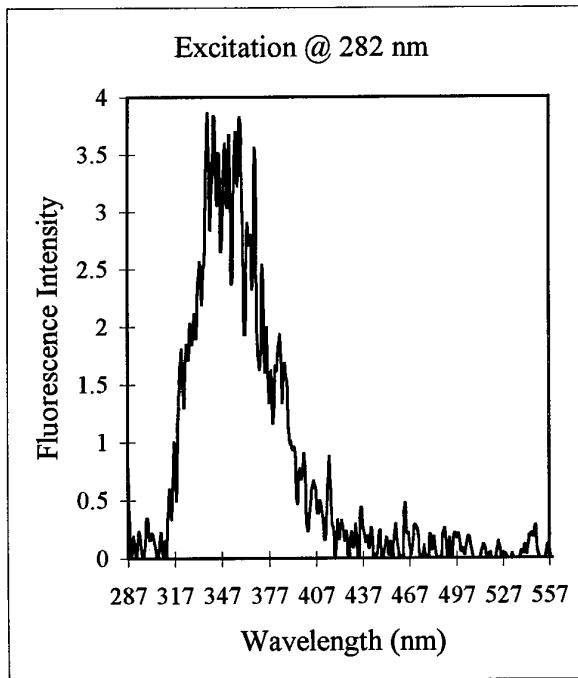


Figure 1 (l) 05/02/97 Modified continental

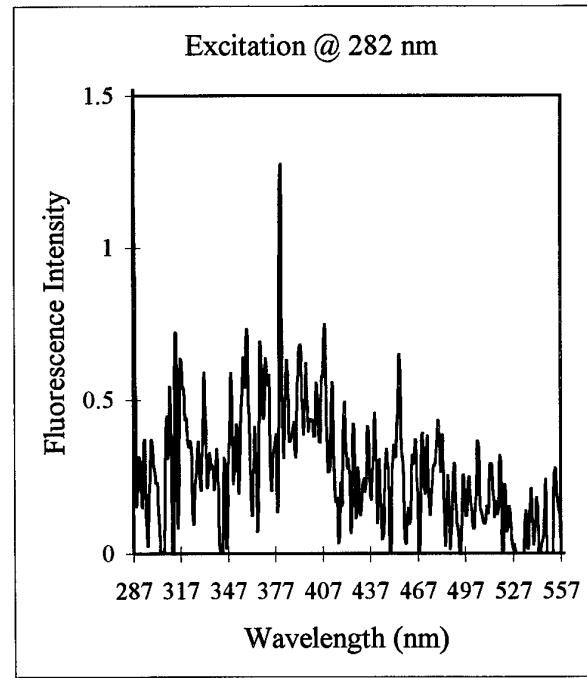


Figure 2 (a) 11/29/96 Marine

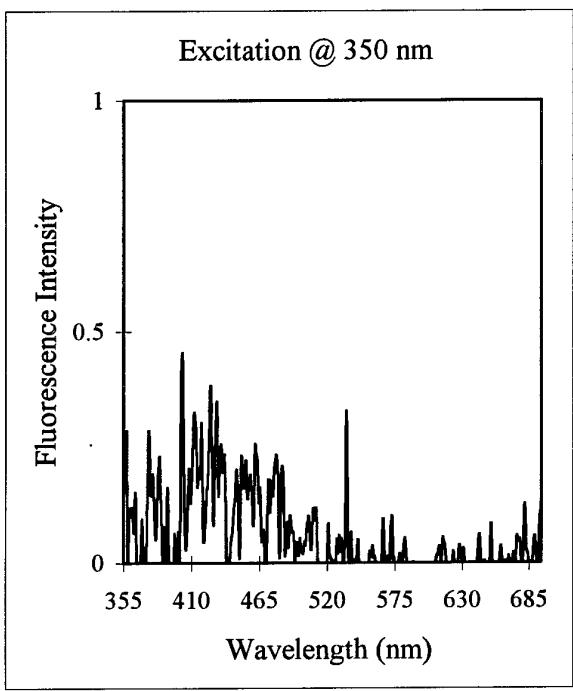


Figure 2 (b) 12/06/96 Modified marine

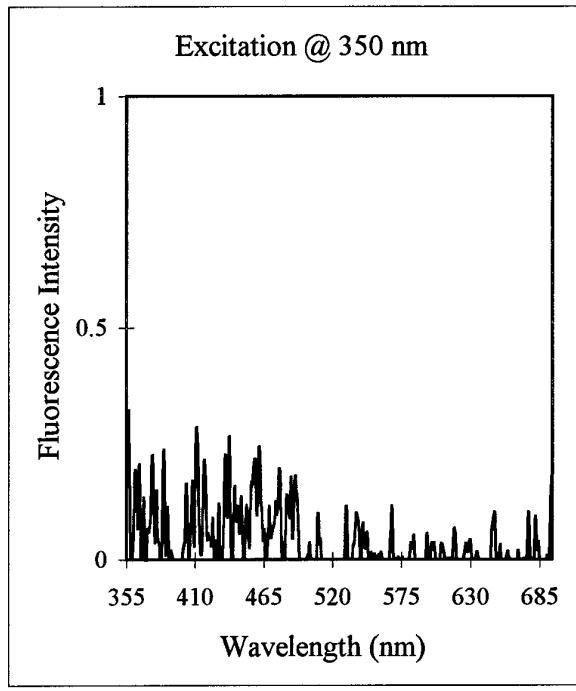


Figure 2 (c) 01/13/97 Marine

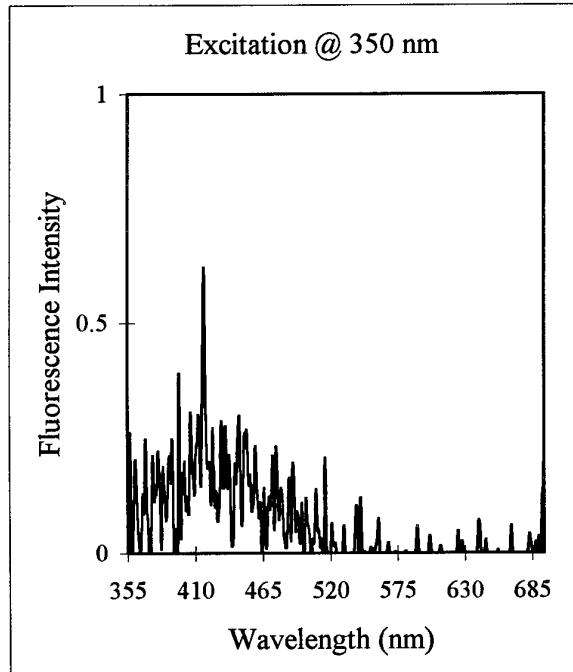


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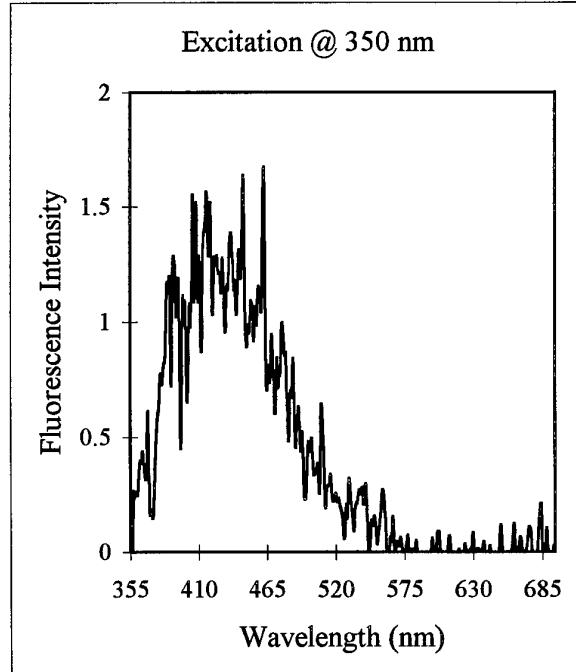


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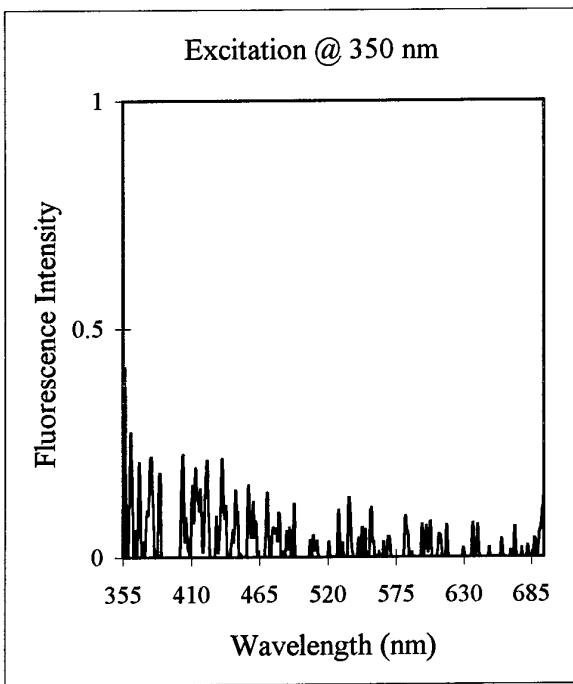


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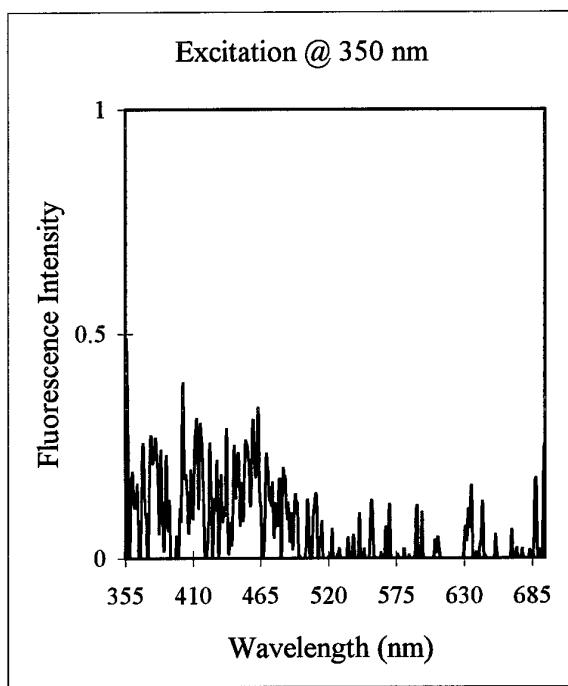


Figure 2 (g) 03/13/97 Marine

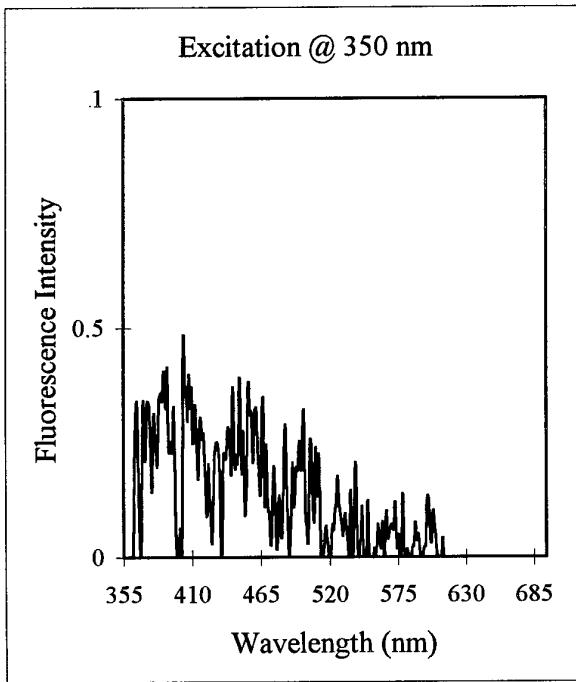


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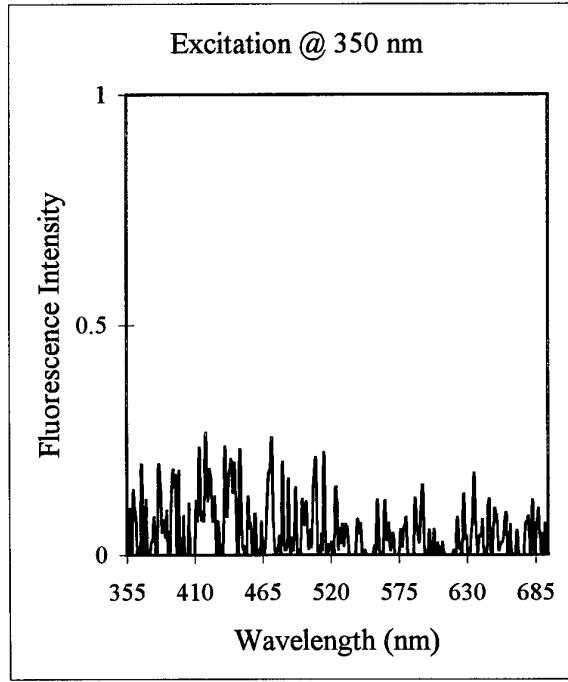


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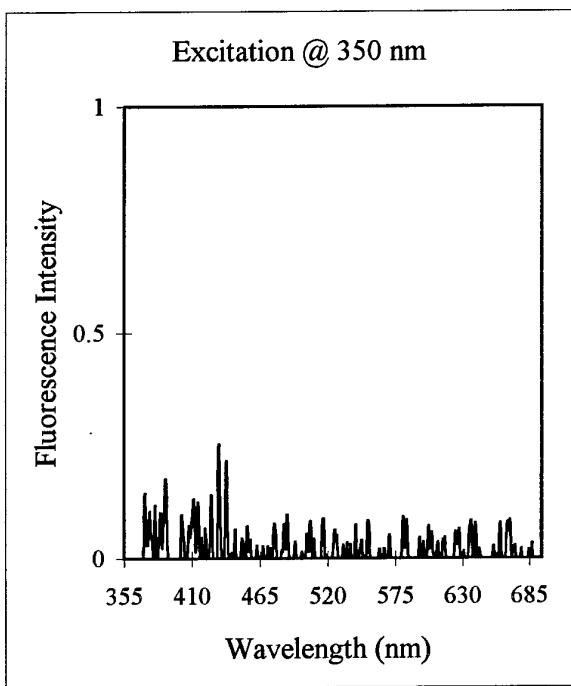


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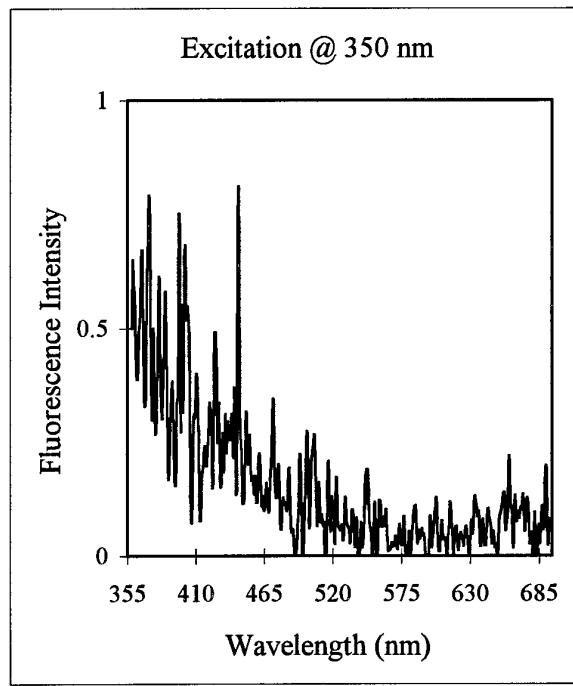


Figure 2 (k) 05/08/97 Modified marine

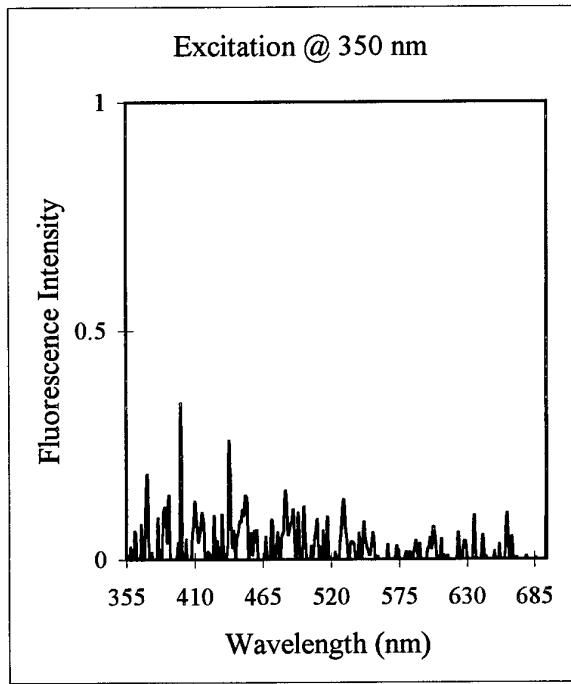


Figure 2 (l) 05/02/97 Modified continental

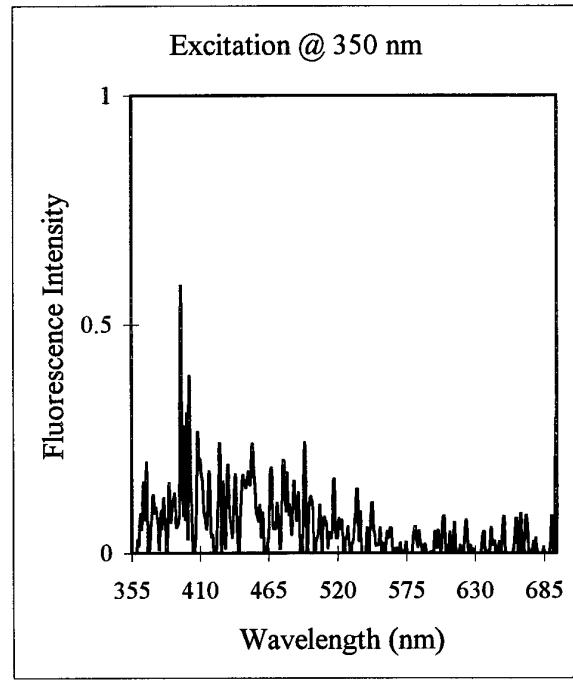


Figure 3 (a) 11/29/96 Marine

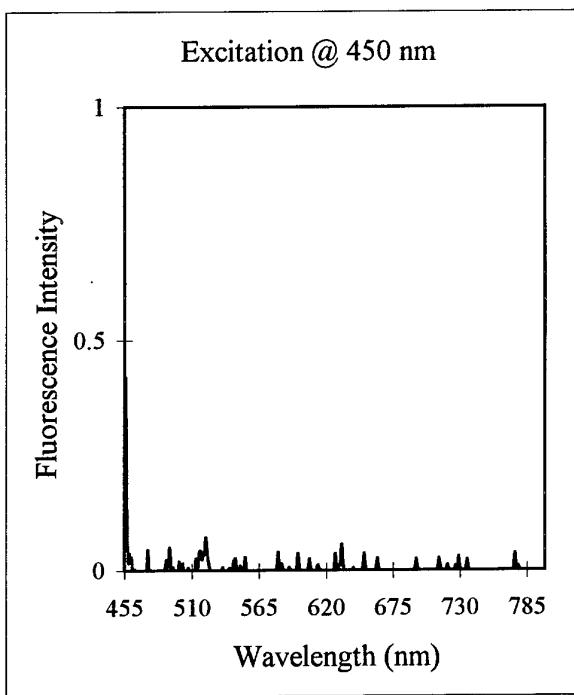


Figure 3 (b) 12/06/96 Modified marine

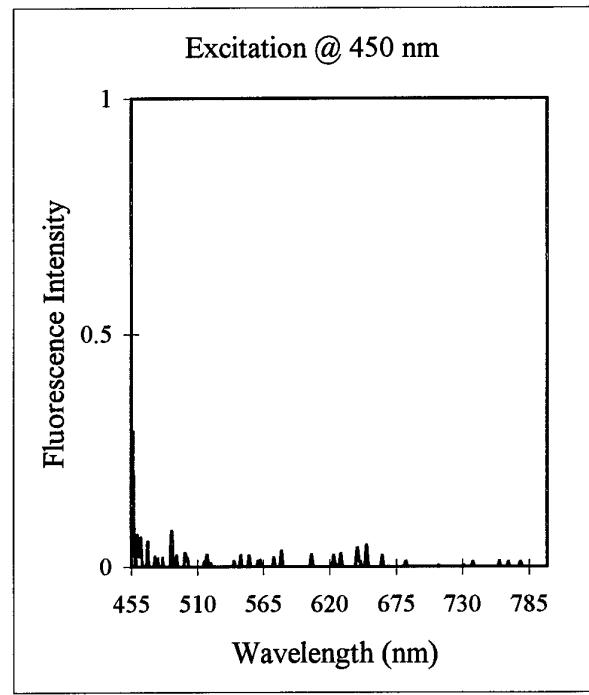


Figure 3 (c) 01/13/97 Marine

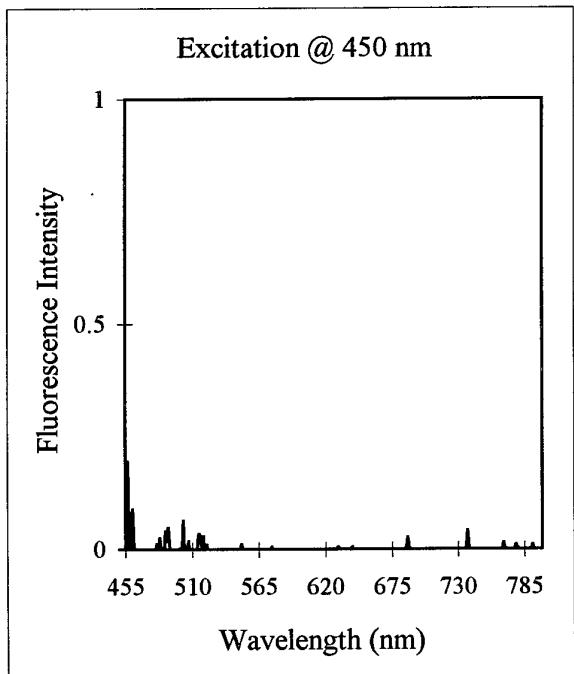


Figure 3 (d) 01/09/97 Continental

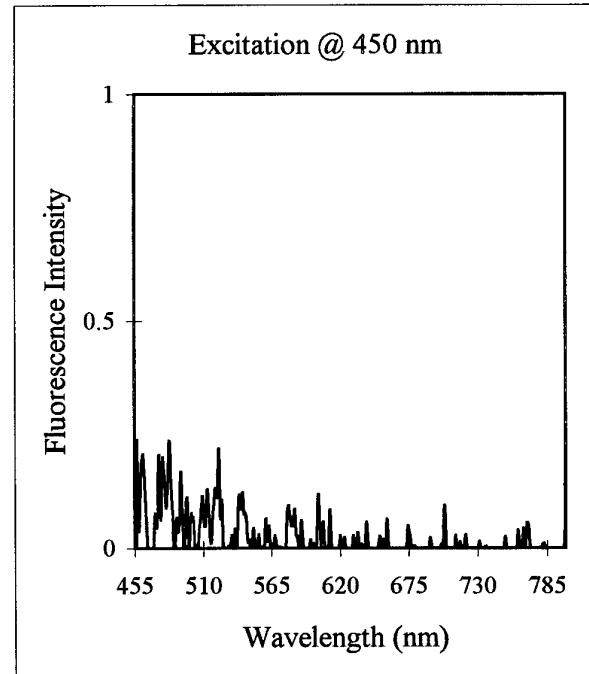


Figure 3 (e) 02/07/97 Modified marine

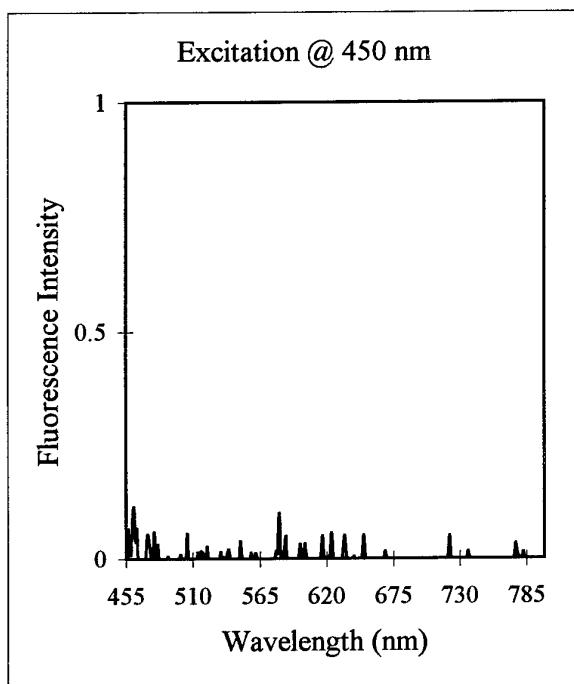


Figure 3 (f) 01/31/97 Continental

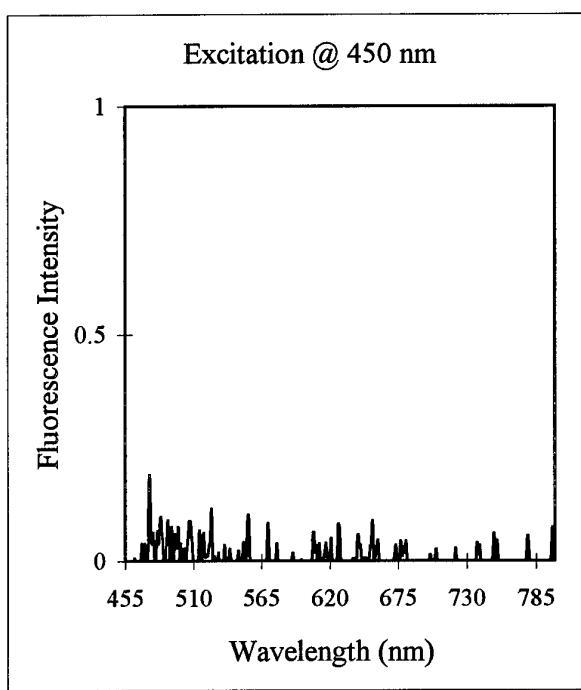


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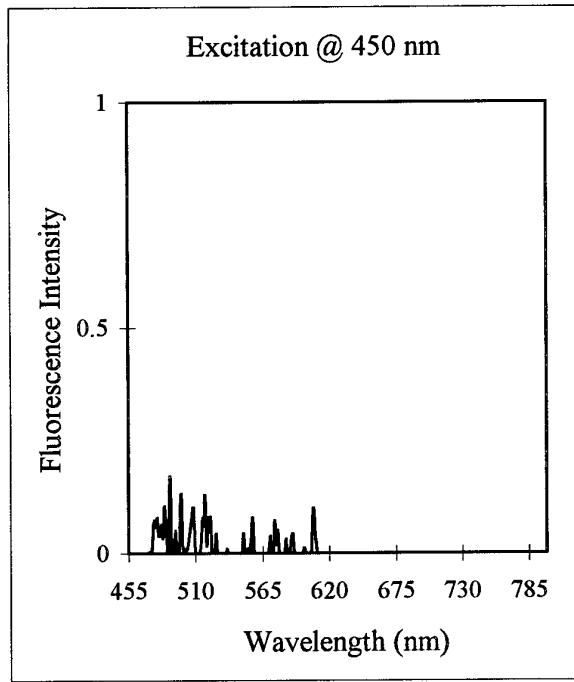


Figure 3 (h) 03/19/97 Marine

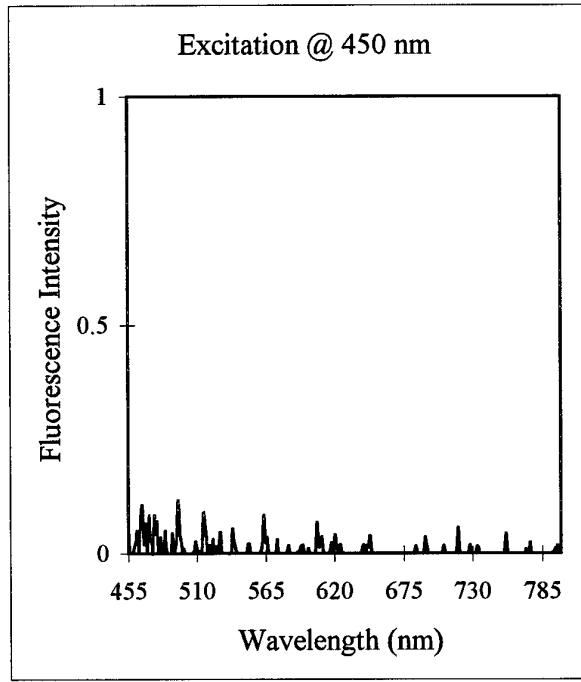


Figure 3 (i) 04/03/97 Modified marine

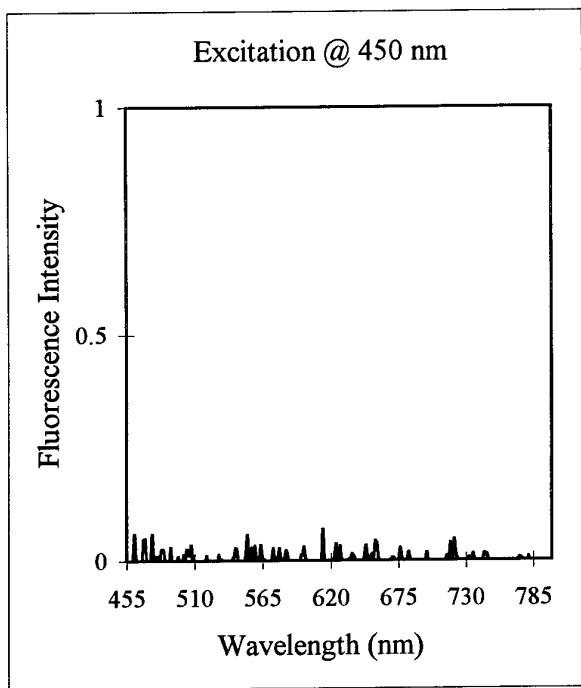


Figure 3 (j) 04/24/97 Marine

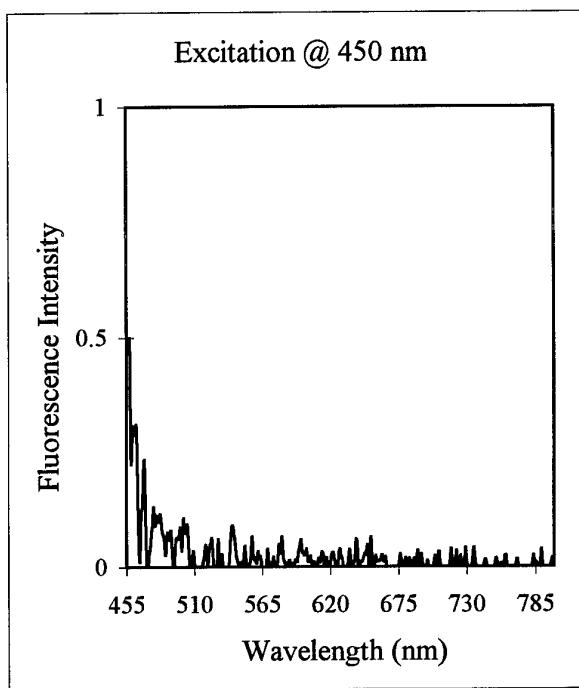


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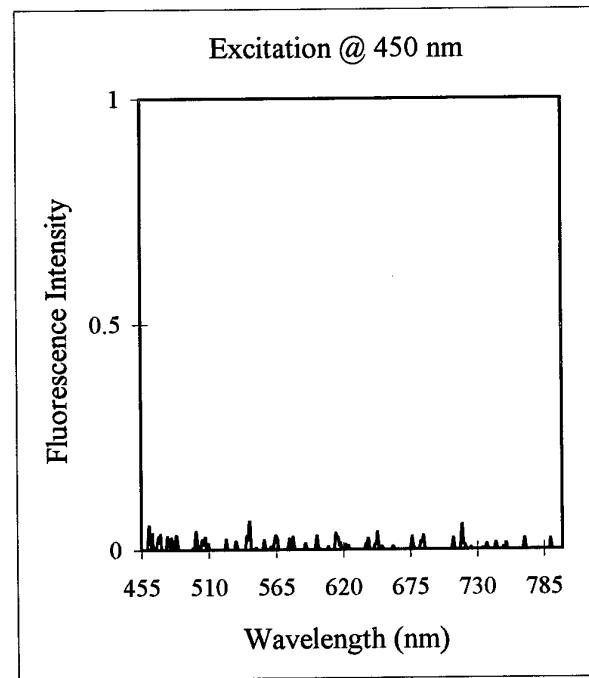
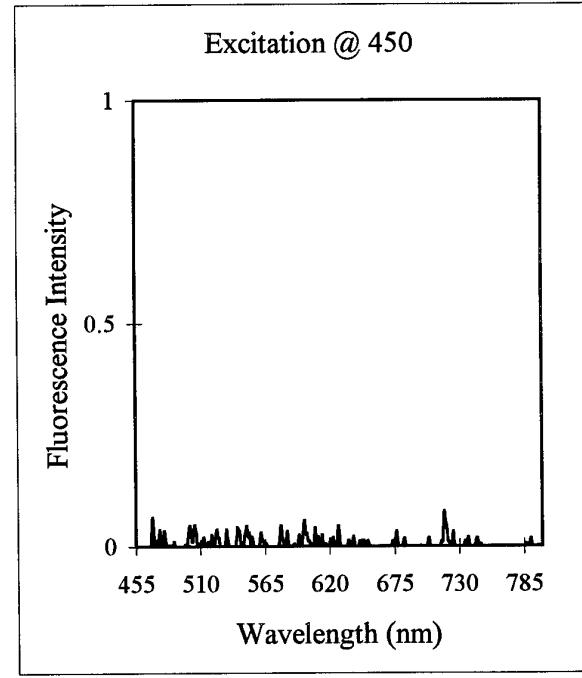


Figure 3 (l) 05/02/97 Modified continental



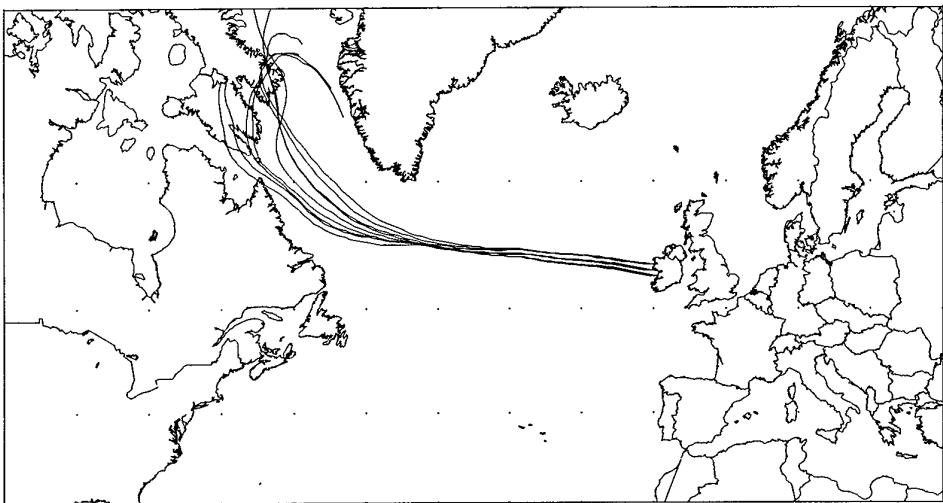


Figure 4 (a) 29 November 1996

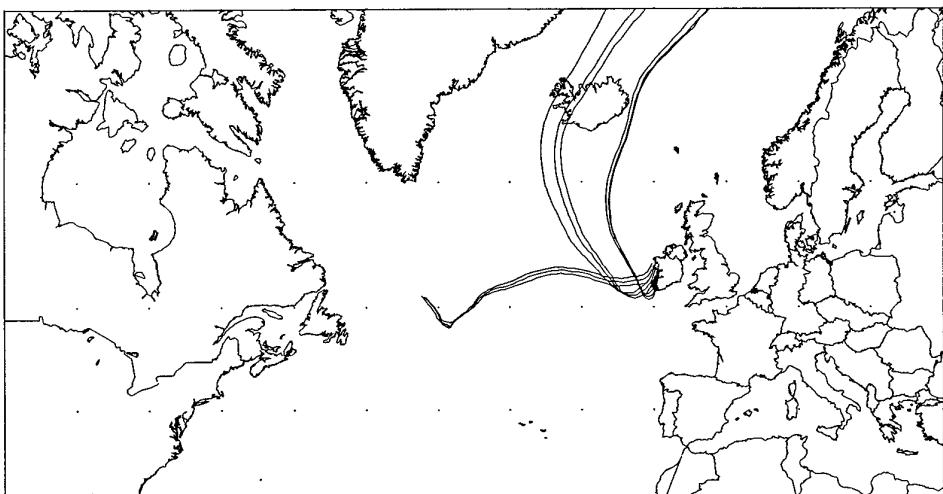


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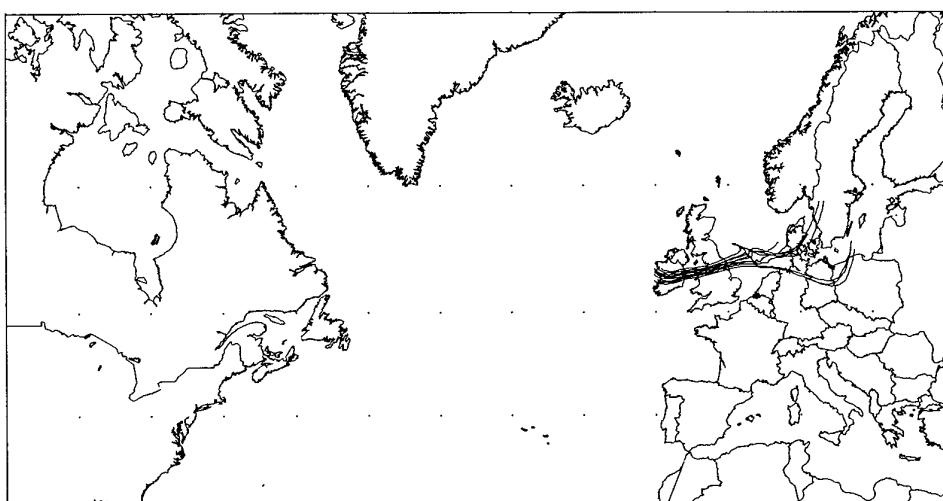


Figure 4 (c) 09 January 1997

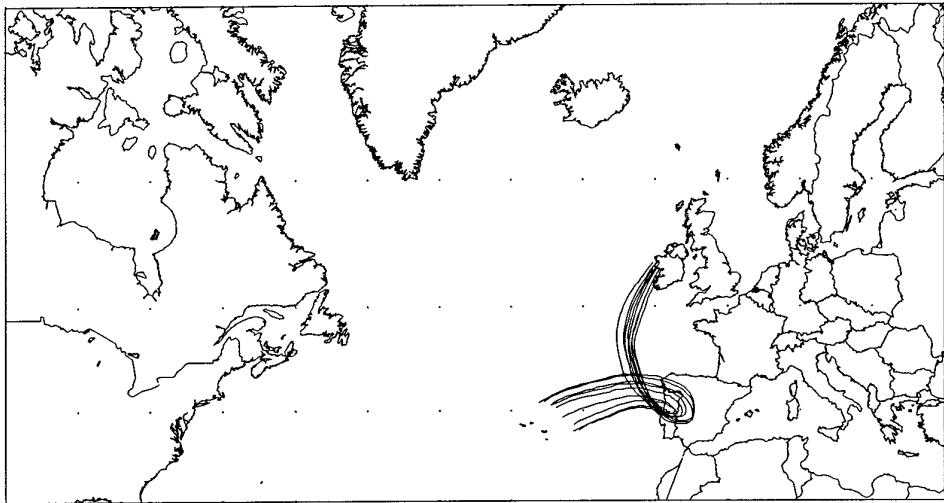


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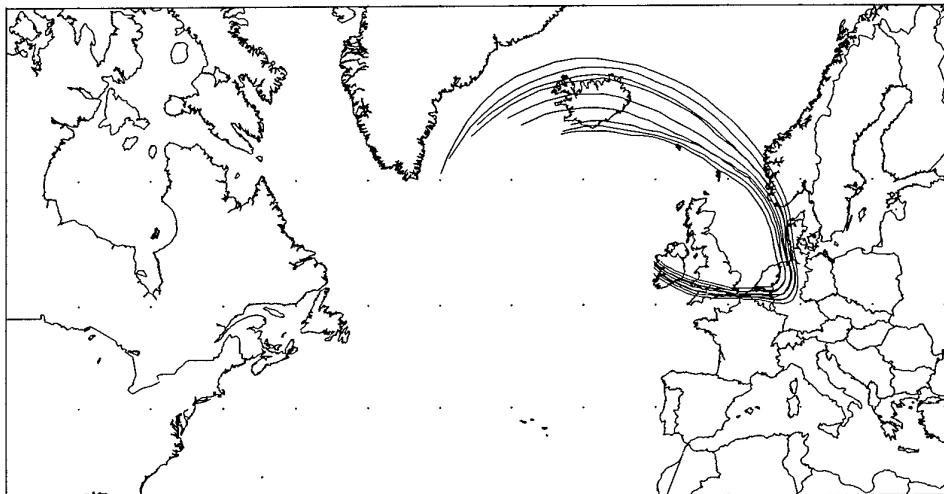


Figure 4 (e) 31 January 1997

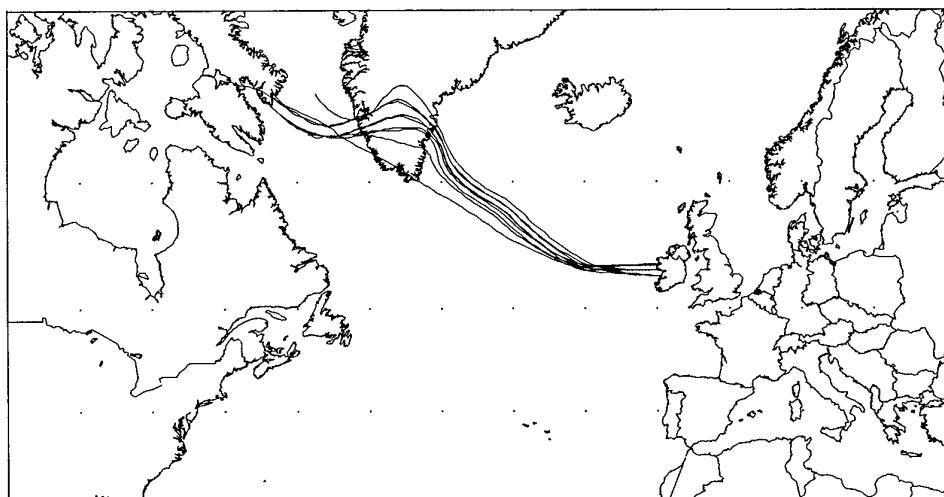


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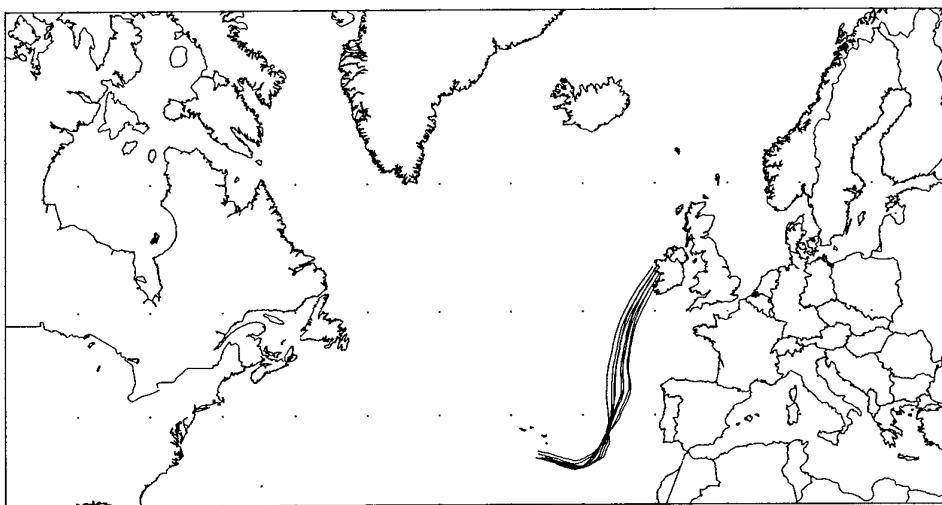


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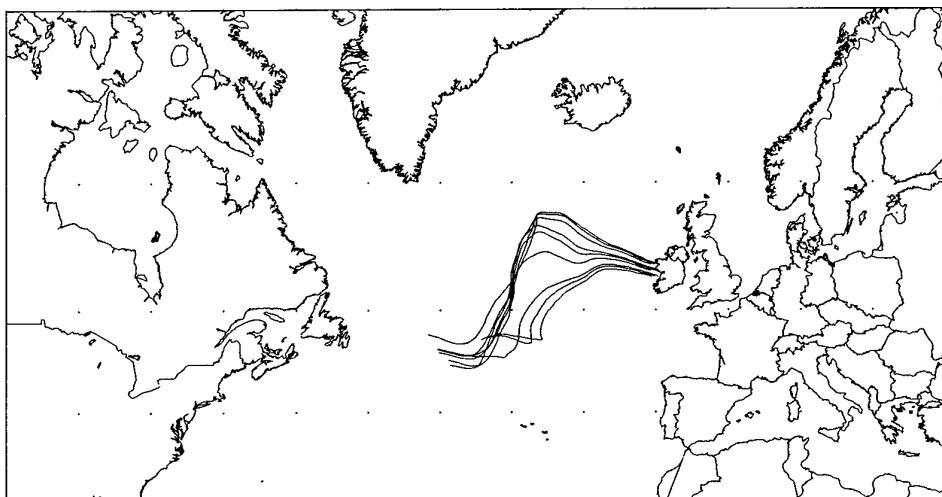


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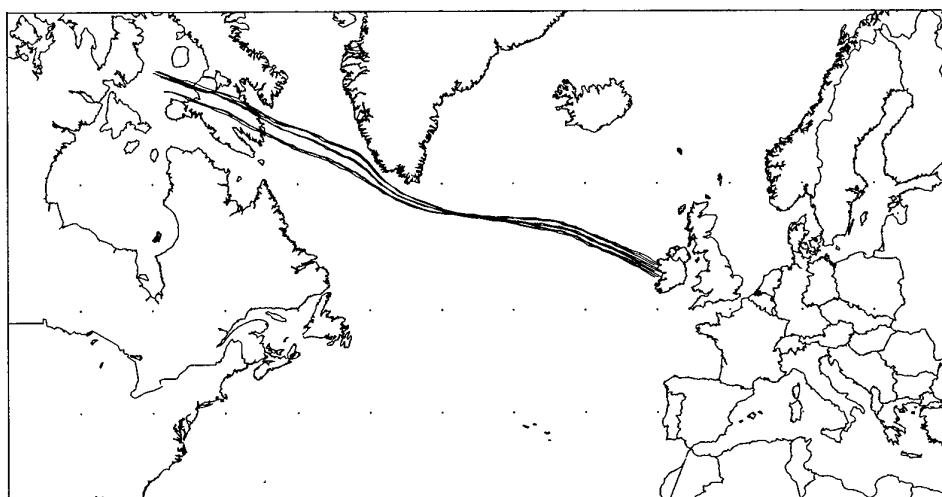


Figure 4 (i) 03 April 1997

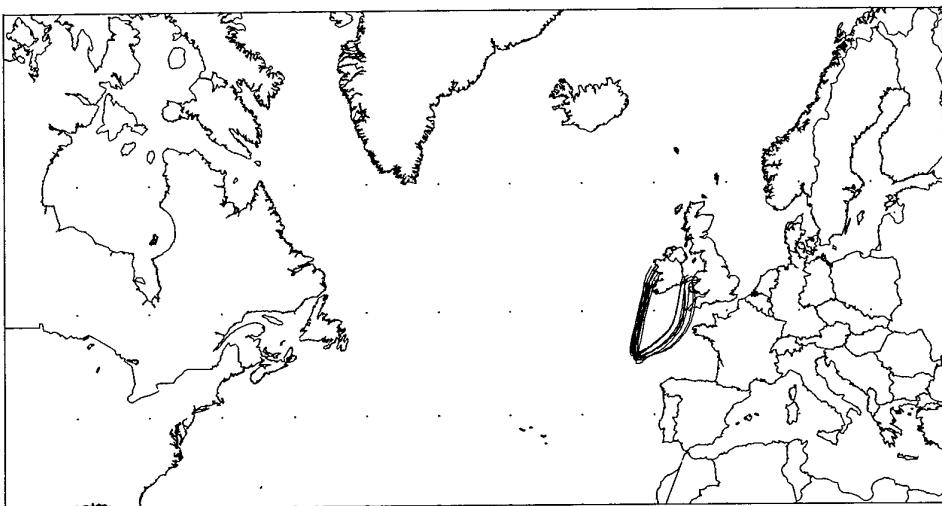


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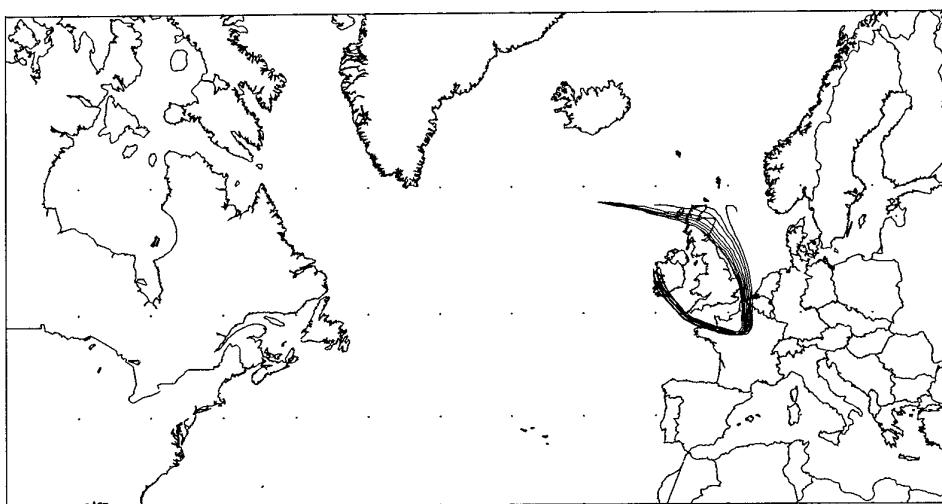


Figure 4 (k) 02 May 1997

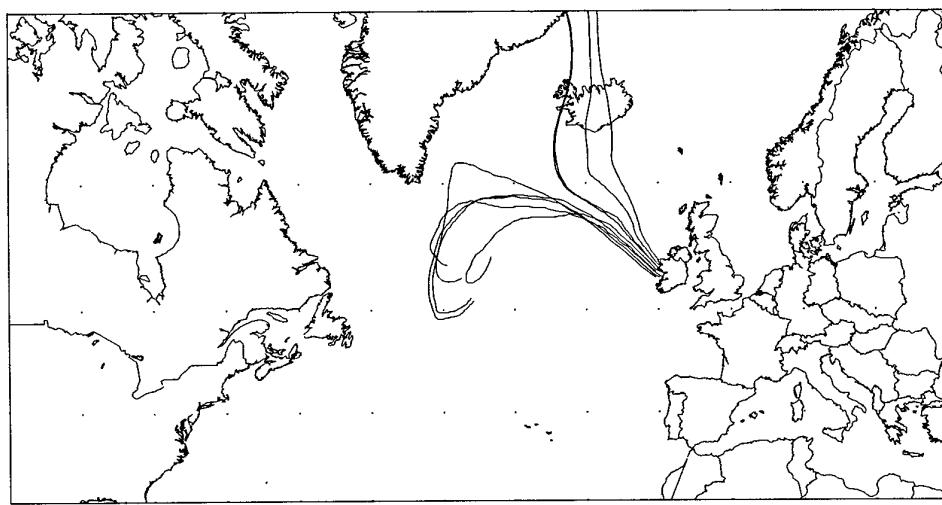


Figure 4 (l) 08 May 1997